

**RESULT LIST**

8 results found in the Worldwide database for:  
**snapshot** in the title AND **metadata** in the title or abstract  
(Results are sorted by date of upload in database)

- 1 METHOD AND DEVICE FOR PERMANENCE OF FILE SYSTEM SNAPSHOT**  
Inventor: ADKINS JANET ELIZABETH; CHANG JOON      Applicant: IBM  
EC:      IPC: G06F12/00  
Publication info: **JP2005228329** - 2005-08-25
- 2 System and methods for transforming data from a source to target platform using snapshot**  
Inventor: ANDRE JEFFREY (US); TOMSULA PATRICK J      Applicant: STORAGE TECHNOLOGY CORP (US)  
(US)  
EC:      IPC: G06F15/16  
Publication info: **US6874035** - 2005-03-29
- 3 Systems and methods of data migration in snapshot operations**  
Inventor: BURTON DAVID ALAN (US); OTTERNESS      Applicant:  
NOEL SIMEN (US)  
EC:      IPC: G06F12/16  
Publication info: **US2004260900** - 2004-12-23
- 4 Snapshot facility allowing preservation of chronological views on block drives**  
Inventor: LIN ALVIS (TW); LIAO CHEEN (TW)      Applicant:  
EC: G06F11/14A4      IPC: G06F12/16  
Publication info: **US2004093474** - 2004-05-13
- 5 Low overhead snapshot in a storage array using a tree-of-slabs metadata**  
Inventor: LEE WHAY SING (US); RAO RAGHAVENDRA J      Applicant:  
(US)  
EC:      IPC: G06F12/00  
Publication info: **US2004078533** - 2004-04-22
- 6 METHOD FOR ACQUIRING SNAPSHOT, STORAGE SYSTEM AND DISK DEVICE**  
Inventor: MIZUNO YOICHI; MATSUNAMI NAOTO; (+3)      Applicant: HITACHI LTD  
EC: G06F11/14A4B1M      IPC: G06F12/00; G06F3/06; (+1)  
Publication info: **JP2003280964** - 2003-10-03
- 7 System and method for storage of snapshot metadata in a remote file**  
Inventor: MANLEY STEPHEN L (GB); CHEN RAYMOND C      Applicant:  
(US); (+1)  
EC: G06F17/30F      IPC: G06F12/00  
Publication info: **US2003182322** - 2003-09-25
- 8 File system snapshot with ditto address feature**  
Inventor: HASKIN ROGER L (US); SAWDON WAYNE A      Applicant: IBM (US)  
(US); (+2)  
EC: G06F17/30F      IPC: G06F12/00  
Publication info: **US2003158863** - 2003-08-21

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**RESULT LIST**

Approximately **44** results found in the Worldwide database for:  
**snapshot** in the title AND **file** in the title or abstract  
(Results are sorted by date of upload in database)

- 1 METHOD AND APPARATUS FOR FILE SYSTEM SNAPSHOT PERSISTANCE**  
Inventor: JANET ELIZABETH ADKINS; JOON CHANG      Applicant: IBM  
EC:      IPC:  
Publication info: **SG114691** - 2005-09-28
- 2 System and method for performing an image level snapshot and for restoring partial volume data**  
Inventor: PRAHLAD ANAND (US); NGO DAVID (US);      Applicant:  
(+3)  
EC:      IPC: G06F7/00  
Publication info: **US2005193026** - 2005-09-01
- 3 SNAPSHOT ACQUISITION METHOD**  
Inventor: KUBO HIROSHI; SUGIYAMA HIROHARU      Applicant: HITACHI LTD  
EC:      IPC: G06F12/00; G06F3/06  
Publication info: **JP2005202915** - 2005-07-28
- 4 Method for acquiring snapshot**  
Inventor: KUBO KEI (JP); SUGIYAMA KOJI (JP)      Applicant:  
EC:      IPC: G06F12/16  
Publication info: **US2005138312** - 2005-06-23
- 5 BLOCK LEVEL DATA SNAPSHOT SYSTEM AND METHOD**  
Inventor: GUTHRIE II JOHN L (US)      Applicant: ZETTA SYSTEMS INC (US); GUTHRIE II JOHN L (US)  
EC:      IPC: G06F  
Publication info: **WO2005052734** - 2005-06-09
- 6 SYSTEM AND METHOD FOR PERFORMING AN IMAGE LEVEL SNAPSHOT AND FOR RESTORING PARTIAL VOLUME DATA**  
Inventor: VARADHARAJAN PRAKASH (IN); PAWAR RAHUAL (IN); (+3)      Applicant: COMMVAULT SYSTEMS INC (US); VARADHARAJAN PRAKASH (IN); (+4)  
EC:      IPC: G06F  
Publication info: **WO2005048085** - 2005-05-26
- 7 Organization of read-write snapshot copies in a data storage system**  
Inventor: TUMMALA HIMABINDU (US); ARMANGAU PHILIPPE (US)      Applicant:  
EC:      IPC: G06F12/00  
Publication info: **US2005065985** - 2005-03-24
- 8 Maintenance of a file version set including read-only and read-write snapshot copies of a production file**  
Inventor: BIXBY PETER (US); MULLICK SACHIN (US);      Applicant:  
(+3)  
EC:      IPC: G06F17/30  
Publication info: **US2005065986** - 2005-03-24
- 9 Providing a snapshot of a subject of a file system**  
Inventor: SAWDON WAYNE A (US); SCHMUCK FRANK B (US)      Applicant: IBM (US)  
EC:      IPC: G06F12/00  
Publication info: **US2005050110** - 2005-03-03
- 10 PROVIDING A SNAPSHOT OF A SUBSET OF A FILE SYSTEM**



**Inventor:** SAWDON WAYNE A; SCHMUCK FRANK B

**Applicant:** IBM

**EC:**

**IPC:** G06F11/14

**Publication info:** **AU2003214039** - 2003-09-04

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**SYSTEM AND METHOD FOR PERFORMING AN IMAGE LEVEL SNAPSHOT AND FOR RESTORING PARTIAL VOLUME DATA****Patent number:** WO2005048085**Publication date:** 2005-05-26**Inventor:** VARADHARAJAN PRAKASH (IN); PAWAR RAHUAL (IN); KUMAR AVINASH (IN); PRAHLAD ANAND (US); NGO DAVID (US)**Applicant:** COMMVault SYSTEMS INC (US); VARADHARAJAN PRAKASH (IN); PAWAR RAHUAL (IN); KUMAR AVINASH (IN); PRAHLAD ANAND (US); NGO DAVID (US)**Classification:****- international:** (IPC1-7): G06F**- european:****Application number:** WO2004US38455 20041115**Priority number(s):** US20030519576P 20031113; US20030519876P 20031113**Also published as:**

WO2005050386 (A2)

**Report a data error here****Abstract of WO2005048085**

The present invention relates to a method for performing an image level copy of an information store. The present invention comprises performing a snapshot of an information store that indexes the contents of the information store, retrieving data associated with the contents of the information store from a file allocation table, copying the contents of the information store to a storage device based on the snapshot, and associating the retrieved data with the copied contents to provide file system information for the copied contents.

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**RESULT LIST**

12 results found in the Worldwide database for:  
**snapshot** in the title AND **address** in the title or abstract  
 (Results are sorted by date of upload in database)

- 1 On-line data backup method based on data volume snapshot**  
 Inventor: LI LIHONG (CN); WU JIANG (CN); (+1)      Applicant: LENOVO BEIJING CO LTD (CN)  
 EC:      IPC: G06F12/16  
 Publication info: **CN1567262** - 2005-01-19
- 2 THIN-PROVISIONING WITH SNAPSHOT TECHNOLOGY**  
 Inventor: CAMERON DOUGLAS J (US)      Applicant: 3PAR DATA INC (US); CAMERON DOUGLAS J (US)  
 EC:      IPC: G06F12/00  
 Publication info: **WO2004102391** - 2004-11-25
- 3 Fibre channel fabric snapshot service**  
 Inventor: KAUSHIK BALAKUMAR N (US);      Applicant: BROCADE COMM SYSTEMS INC (US)  
 BALASUBRAMANIAN SHANKAR (US); (+1)  
 EC: H04L29/08A7      IPC: G06F12/00  
 Publication info: **US2004220971** - 2004-11-04
- 4 Organization of multiple snapshot copies in a data storage system**  
 Inventor: ARMANGAU PHILIPPE (US); BERGANT MILENA      Applicant:  
 (US); (+3)  
 EC:      IPC: G06F17/30  
 Publication info: **US2004030727** - 2004-02-12
- 5 Writable file system snapshot with ditto address feature**  
 Inventor: SAWDON WAYNE A (US); SCHMUCK FRANK B      Applicant: IBM (US)  
 (US); (+1)  
 EC: G06F17/30F      IPC: G06F7/00  
 Publication info: **US2003158834** - 2003-08-21
- 6 File system snapshot with ditto address feature**  
 Inventor: HASKIN ROGER L (US); SAWDON WAYNE A      Applicant: IBM (US)  
 (US); (+2)  
 EC: G06F17/30F      IPC: G06F12/00  
 Publication info: **US2003158863** - 2003-08-21
- 7 Copy method supplementing outboard data copy with previously  
 instituted copy-on-write logical snapshot to create duplicate consistent  
 with source data as of designated time**  
 Inventor: KACZMARSKI MICHAEL ALLEN (US); WARREN      Applicant:  
 DONALD PAUL (US)  
 EC:      IPC: G06F12/00  
 Publication info: **US2003140070** - 2003-07-24
- 8 System and method for remotely creating a physical memory snapshot  
 over a serial bus**  
 Inventor: VACHON ANDRE F (US);      Applicant:  
 CHRYSANTHAKOPOULOS GEORGIOS (US)  
 EC:      IPC: G06F11/26  
 Publication info: **US2002078404** - 2002-06-20
- 9 Snapshot and recall based mechanism to handle read after read  
 conflict**  
 Inventor: GUPTA C NAGESH (US)      Applicant: HEWLETT PACKARD CO (US)  
 EC: G06F13/42C1S      IPC: G06F13/14; G06F12/00  
 Publication info: **US6449673** - 2002-09-10
- 10 System and method for real-time data backup using snapshot copying**



**with selective compaction of backup data**

**Inventor:** FRANKLIN CHRIS (US)

**Applicant:** ADAPTEC INC (US)

**EC:**

**IPC:** G06F12/00; G06F12/16

**Publication Info:** **US6061770** - 2000-05-09

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21 results found in the Worldwide database for:  
**snapshot** in the title AND **disk** in the title or abstract  
(Results are sorted by date of upload in database)

- 1 DISK ARRAY DEVICE WITH SNAPSHOT SIMULATION FUNCTION**  
Inventor: SAKAI TOSHIHIRO      Applicant: NIPPON ELECTRIC CO  
EC:      IPC: G06F3/06  
Publication info: **JP2005128590** - 2005-05-19
- 2 BLOCK LEVEL DATA SNAPSHOT SYSTEM AND METHOD**  
Inventor: GUTHRIE II JOHN L (US)      Applicant: ZETTA SYSTEMS INC (US); GUTHRIE II JOHN L (US)  
EC:      IPC: G06F  
Publication info: **WO2005052734** - 2005-06-09
- 3 SNAPSHOT QUICKENING METHOD**  
Inventor: HARUMA YUMIKO; SUGIYAMA HIROHARU;      Applicant: HITACHI LTD  
(+3)  
EC:      IPC: G06F3/06  
Publication info: **JP2005055972** - 2005-03-03
- 4 System and methods for transforming data from a source to target platform using snapshot**  
Inventor: ANDRE JEFFREY (US); TOMSULA PATRICK J      Applicant: STORAGE TECHNOLOGY CORP (US)  
(US)  
EC:      IPC: G06F15/16  
Publication info: **US6874035** - 2005-03-29
- 5 Snapshot marker**  
Inventor: LAM WAI (US)      Applicant:  
EC: G06F12/08B2      IPC: G06F12/08; G06F12/16  
Publication info: **US2005005070** - 2005-01-06
- 6 THIN-PROVISIONING WITH SNAPSHOT TECHNOLOGY**  
Inventor: CAMERON DOUGLAS J (US)      Applicant: 3PAR DATA INC (US); CAMERON DOUGLAS J (US)  
EC:      IPC: G06F12/00  
Publication info: **WO2004102391** - 2004-11-25
- 7 Persistent Snapshot Methods**  
Inventor: WELSH ALAN L (US); TOLPIN RICHARD M      Applicant: COLUMBIA DATA PRODUCTS INC (US)  
(US); (+8)  
EC:      IPC: G06F12/16  
Publication info: **US2004117572** - 2004-06-17
- 8 System and method of an efficient snapshot for shared large storage**  
Inventor: KIM YOUNG HO (KR); KANG DONG JAE (KR); Applicant:  
(+4)  
EC: G06F11/14A4B1M8      IPC: G06F12/16  
Publication info: **US2004083345** - 2004-04-29
- 9 Snapshot creating method and apparatus**  
Inventor: HARA JUNICHI (JP); NAKANO TAKAHIRO (JP); Applicant:  
(+3)  
EC:      IPC: G06F17/00; G06F7/00  
Publication info: **US2004103104** - 2004-05-27
- 10 Persistent Snapshot Management System**  
Inventor: GREEN ROBBIE A (US); MUIRRAGUI      Applicant:  
PATRICIO R (US); (+8)  
EC:      IPC: G06F12/12



Publication Info: **US2003167380** - 2003-09-04

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2 results found in the Worldwide database for:

**inode** in the title AND **snapshot** in the title or abstract

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**1 System and method for asynchronous mirroring of snapshots at a destination using a purgatory directory and inode mapping**

Inventor: MANLEY STEPHEN L (GB); OWARA SHANE S Applicant:

(US)

EC: G06F11/20L4M8A; G06F17/30F

IPC: G06F12/00

Publication info: **US2003195903** - 2003-10-16

**2 System and method for asynchronous mirroring of snapshots at a destination using a purgatory directory and inode mapping**

Inventor: MANLEY STEPHEN L (GB); OWARA SHANE S Applicant:

(US)

EC: G06F11/20L4M8A; G06F17/30F

IPC: G06F12/00

Publication info: **US2003182325** - 2003-09-25

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# 1 [Improving storage system availability with D-GRAID](#)



Muthian Sivathanu, Vijayan Prabhakaran, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau

 May 2005 **ACM Transactions on Storage (TOS)**, Volume 1 Issue 2

Publisher: ACM Press

 Full text available: [pdf\(700.30 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present the design, implementation, and evaluation of D-GRAID, a gracefully degrading and quickly recovering RAID storage array. D-GRAID ensures that most files within the file system remain available even when an unexpectedly high number of faults occur. D-GRAID achieves high availability through aggressive replication of semantically critical data, and fault-isolated placement of logically related data. D-GRAID also recovers from failures quickly, restoring only live file system data to a h ...

**Keywords:** Block-based storage, Disk array, RAID, fault isolation, file systems, smart disks

# 2 [The logical disk: a new approach to improving file systems](#)



Wiebren de Jonge, M. Frans Kaashoek, Wilson C. Hsieh

 December 1993 **ACM SIGOPS Operating Systems Review , Proceedings of the fourteenth ACM symposium on Operating systems principles SOSP '93**, Volume 27 Issue 5

Publisher: ACM Press

 Full text available: [pdf\(1.55 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The Logical Disk (LD) defines a new interface to disk storage that separates file management and disk management by using logical block numbers and block lists. The LD interface is designed to support multiple file systems and to allow multiple implementations, both of which are important given the increasing use of kernels that support multiple operating system personalities. A log-structured implementation of LD (LLD) demonstrates that LD can be implemented efficiently. LLD adds about 5% to 10% ...

**Keywords:** MINIX, UNIX, disk storage management, file system organization, file system performance, high write performance, log-structured file system, logical disk



### 3 Serverless network file systems



Thomas E. Anderson, Michael D. Dahlin, Jeanna M. Neefe, David A. Patterson, Drew S. Roselli, Randolph Y. Wang  
February 1996 **ACM Transactions on Computer Systems (TOCS)**, Volume 14 Issue 1

Publisher: ACM Press

Full text available: pdf(2.69 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We propose a new paradigm for network file system design: serverless network file systems. While traditional network file systems rely on a central server machine, a serverless system utilizes workstations cooperating as peers to provide all file system services. Any machine in the system can store, cache, or control any block of data. Our approach uses this location independence, in combination with fast local area networks, to provide better performance and scalability th ...

**Keywords:** RAID, log cleaning, log structured, log-based striping, logging, redundant data storage, scalable performance

### 4 Serverless network file systems



T. E. Anderson, M. D. Dahlin, J. M. Neefe, D. A. Patterson, D. S. Roselli, R. Y. Wang  
December 1995 **ACM SIGOPS Operating Systems Review , Proceedings of the fifteenth ACM symposium on Operating systems principles SOSP '95**, Volume 29 Issue 5

Publisher: ACM Press

Full text available: pdf(2.48 MB)

Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

### 5 Doubly distorted mirrors



Cyril U. Orji, Jon A. Solworth  
June 1993 **ACM SIGMOD Record , Proceedings of the 1993 ACM SIGMOD international conference on Management of data SIGMOD '93**, Volume 22 Issue 2

Publisher: ACM Press

Full text available: pdf(1.05 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Traditional mirrored disk systems provide high reliability by multiplexing disks. Performance is improved with parallel reads and shorter read seeks. However, writes must be performed by both disks, limiting performance. Doubly distorted mirrors increase the number of physical writes per logical write from 2 to 3, but performs logical writes more efficiently. This reduces the cost of a random logical write to 1/3 of the cost of a read. Moreover, much of the write ...

### 6 File system aging—increasing the relevance of file system benchmarks



Keith A. Smith, Margo I. Seltzer  
June 1997 **ACM SIGMETRICS Performance Evaluation Review , Proceedings of the 1997 ACM SIGMETRICS international conference on Measurement and modeling of computer systems SIGMETRICS '97**, Volume 25 Issue 1

Publisher: ACM Press

Full text available: pdf(1.81 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Benchmarks are important because they provide a means for users and researchers to characterize how their workloads will perform on different systems and different system architectures. The field of file system design is no different from other areas of research in this regard, and a variety of file system benchmarks are in use, representing a wide range of the different user workloads that may be run on a file system. A realistic benchmark,




however, is only one of the tools that is required in ...

## 7 Scale and performance in a distributed file system

 John H. Howard, Michael L. Kazar, Sherri G. Menees, David A. Nichols, M. Satyanarayanan, Robert N. Sidebotham, Michael J. West

February 1988 **ACM Transactions on Computer Systems (TOCS)**, Volume 6 Issue 1

**Publisher:** ACM Press

Full text available:  pdf(2.38 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citings](#), [index terms](#), [review](#)

The Andrew File System is a location-transparent distributed tile system that will eventually span more than 5000 workstations at Carnegie Mellon University. Large scale affects performance and complicates system operation. In this paper we present observations of a prototype implementation, motivate changes in the areas of cache validation, server process structure, name translation, and low-level storage representation, and quantitatively demonstrate Andrews ability to scale gracefully. W ...

## 8 Ext3cow: a time-shifting file system for regulatory compliance

 Zachary Peterson, Randal Burns

May 2005 **ACM Transactions on Storage (TOS)**, Volume 1 Issue 2

**Publisher:** ACM Press


Full text available:  pdf(443.01 KB)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The ext3cow file system, built on the popular ext3 file system, provides an open-source file versioning and snapshot platform for compliance with the versioning and auditability requirements of recent electronic record retention legislation. Ext3cow provides a *time-shifting* interface that permits a real-time and continuous view of data in the past. Time-shifting does not pollute the file system namespace nor require snapshots to be mounted as a separate file system. Further, ext3cow is i ...

**Keywords:** Versioning file systems, copy-on-write

## 9 A high performance multi-structured file system design

 Keith Muller, Joseph Pasquale

September 1991 **ACM SIGOPS Operating Systems Review , Proceedings of the thirteenth ACM symposium on Operating systems principles SOSP '91**, Volume 25 Issue 5

**Publisher:** ACM Press

Full text available:  pdf(1.40 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citings](#), [index terms](#)

File system I/O is increasingly becoming a performance bottleneck in large distributed computer systems. This is due to the increased file I/O demands of new applications, the inability of any single storage structure to respond to these demands, and the slow decline of, disk access times (latency and seek) relative to the rapid increase in CPU speeds, memory size, and network bandwidth. We present a *multi-structured file system* designed for high bandwidth I/O and fast response. Our design ...

## 10 IRON file systems

 Vijayan Prabhakaran, Lakshmi N. Bairavasundaram, Nitin Agrawal, Haryadi S. Gunawi, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau

October 2005 **ACM SIGOPS Operating Systems Review , Proceedings of the twentieth ACM symposium on Operating systems principles SOSP '05**, Volume 39 Issue 5

**Publisher:** ACM Press

Full text available:  pdf(323.82 KB)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)



Commodity file systems trust disks to either work or fail completely, yet modern disks exhibit more complex failure modes. We suggest a new *fail-partial failure model* for disks, which incorporates realistic localized faults such as latent sector errors and block corruption. We then develop and apply a novel *failure-policy fingerprinting* framework, to investigate how commodity file systems react to a range of more realistic disk failures. We classify their failure policies in a new ...

**Keywords:** IRON file systems, block corruption, disks, fail-partial failure model, fault tolerance, internal, latent sector errors, redundancy, reliability, storage

# 11 Improving the performance of log-structured file systems with adaptive methods



Jeanna Neeffe Matthews, Drew Roselli, Adam M. Costello, Randolph Y. Wang, Thomas E. Anderson

October 1997 **ACM SIGOPS Operating Systems Review , Proceedings of the sixteenth ACM symposium on Operating systems principles SOSP '97**, Volume 31 Issue 5

**Publisher:** ACM Press

Full text available: [pdf\(2.18 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)



# 12 Fast and secure distributed read-only file system



Kevin Fu, M. Frans Kaashoek, David Mazières

February 2002 **ACM Transactions on Computer Systems (TOCS)**, Volume 20 Issue 1

**Publisher:** ACM Press

Full text available: [pdf\(317.54 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)



Internet users increasingly rely on publicly available data for everything from software installation to investment decisions. Unfortunately, the vast majority of public content on the Internet comes with no integrity or authenticity guarantees. This paper presents the self-certifying read-only file system, a content distribution system providing secure, scalable access to public, read-only data. The read-only file system makes the security of published content independent from that of the distri ...

**Keywords:** File systems, read-only, security

# 13 Reimplementing the Cedar file system using logging and group commit



R. Hagmann

November 1987 **ACM SIGOPS Operating Systems Review , Proceedings of the eleventh ACM Symposium on Operating systems principles SOSP '87**, Volume 21 Issue 5

**Publisher:** ACM Press

Full text available: [pdf\(775.94 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)



The workstation file system for the Cedar programming environment was modified to improve its robustness and performance. Previously, the file system used hardware-provided labels on disk blocks to increase robustness against hardware and software errors. The new system does not require hardware disk labels, yet is more robust than the old system. Recovery is rapid after a crash. The performance of operations on file system metadata, e.g., file creation or open, is greatly improved. < ...

# 14 An end-to-end approach to globally scalable network storage

Micah Beck, Terry Moore, James S. Plank

August 2002 **ACM SIGCOMM Computer Communication Review , Proceedings of the**







**2002 conference on Applications, technologies, architectures, and protocols for computer communications SIGCOMM '02**, Volume 32 Issue 4

**Publisher:** ACM Press

Full text available: pdf(286.82 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper discusses the application of end-to-end design principles, which are characteristic of the architecture of the Internet, to network storage. While putting storage into the network fabric may seem to contradict end-to-end arguments, we try to show not only that there is no contradiction, but also that adherence to such an approach is the key to achieving true scalability of shared network storage. After discussing end-to-end arguments with respect to several properties of network storage ...

**Keywords:** IBP, asynchronous communications, end-to-end design, exNode, internet backplane protocol, logistical networking, network storage, scalability, store and forward network, wide area storage

**15 Fault tolerance under UNIX**



Anita Borg, Wolfgang Blau, Wolfgang Graetsch, Ferdinand Herrmann, Wolfgang Oberle  
January 1989 **ACM Transactions on Computer Systems (TOCS)**, Volume 7 Issue 1

**Publisher:** ACM Press

Full text available: pdf(1.97 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

The initial design for a distributed, fault-tolerant version of UNIX based on three-way atomic message transmission was presented in an earlier paper [3]. The implementation effort then moved from Auragen Systems<sup>1</sup> to Nixdorf Computer where it was completed. This paper describes the working system, now known as the TARGON/32. The original design left open questions in at least two areas: fault tolerance for server processes and recovery after a crash were brief ...

**16 Replication in the harp file system**



Barbara Liskov, Sanjay Ghemawat, Robert Gruber, Paul Johnson, Liuba Shrira  
September 1991 **ACM SIGOPS Operating Systems Review , Proceedings of the thirteenth ACM symposium on Operating systems principles SOSP '91**, Volume 25 Issue 5

**Publisher:** ACM Press

Full text available: pdf(1.60 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper describes the design and implementation of the Harp file system. Harp is a replicated Unix file system accessible via the VFS interface. It provides highly available and reliable storage for files and guarantees that file operations are executed atomically in spite of concurrency and failures. It uses a novel variation of the primary copy replication technique that provides good performance because it allows us to trade disk accesses for network communication. Harp is intended to be used ...

**17 X-RAY: A Non-Invasive Exclusive Caching Mechanism for RAIDs**



Lakshmi N. Bairavasundaram, Muthian Sivathanu, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau  
March 2004 **ACM SIGARCH Computer Architecture News , Proceedings of the 31st annual international symposium on Computer architecture ISCA '04**, Volume 32 Issue 2

**Publisher:** IEEE Computer Society, ACM Press

Full text available: pdf(250.59 KB) Additional Information: [full citation](#), [abstract](#), [citations](#)

RAID storage arrays often possess gigabytes of RAM for caching disk blocks. Currently,



most RAID systems use LRU or LRU-like policies to manage these caches. Since these array caches do not recognize the presence of file system buffer caches, they redundantly retain many of the same blocks as those cached by the file system, thereby wasting precious cache space. In this paper, we introduce X-RAY, an exclusive RAID array caching mechanism. X-RAY achieves a high degree of (but not perfect) exclusivity through ...

### 18 Design and implementation of a configurable mixed-media file system



Silvano Maffei

October 1994 **ACM SIGOPS Operating Systems Review**, Volume 28 Issue 4

**Publisher:** ACM Press

Full text available: pdf(333.42 KB) Additional Information: [full citation](#), [abstract](#), [index terms](#)

In this paper we describe the design and implementation of a configurable mixed-media file system. The attribute *configurable* means that a file system serving a specific application area can be realized out of a library of reusable file system classes. The attribute *mixed-media* stands for the file system's ability to integrate different media types (RAM, harddisks, WORM optical disks, CDRoms, tape devices, RAID's etc.) into a virtual storage, and making applications unaware of this ...

### 19 A cryptographic file system for UNIX



Matt Blaze

December 1993 **Proceedings of the 1st ACM conference on Computer and communications security**

**Publisher:** ACM Press

Full text available: pdf(955.62 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Although cryptographic techniques are playing an increasingly important role in modern computing system security, user-level tools for encrypting file data are cumbersome and suffer from a number of inherent vulnerabilities. The Cryptographic File System (CFS) pushes encryption services into the file system itself. CFS supports secure storage at the system level through a standard Unix file system interface to encrypted files. Users associate a cryptographic key with the directories ...

### 20 Recovery in the Calypso file system



Murthy Devarakonda, Bill Kish, Ajay Mohindra

August 1996 **ACM Transactions on Computer Systems (TOCS)**, Volume 14 Issue 3

**Publisher:** ACM Press

Full text available: pdf(318.88 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

This article presents the design and implementation of the recovery scheme in Calypso. Calypso is a cluster-optimized, distributed file system for UNIX clusters. As in Sprite and AFS, Calypso servers are stateful and scale well to a large number of clients. The recovery scheme in Calypso is nondisruptive, meaning that open files remain open, client modified data are saved, and in-flight operations are properly handled across server recover. The scheme uses distributed state amount the client ...

**Keywords:** Calypso, cluster systems, distributed state, state reconstruction



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### 1 [Ext3cow: a time-shifting file system for regulatory compliance](#)



Zachary Peterson, Randal Burns

May 2005 **ACM Transactions on Storage (TOS)**, Volume 1 Issue 2

Publisher: ACM Press

Full text available: [pdf\(443.01 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The ext3cow file system, built on the popular ext3 file system, provides an open-source file versioning and snapshot platform for compliance with the versioning and auditability requirements of recent electronic record retention legislation. Ext3cow provides a *time-shifting* interface that permits a real-time and continuous view of data in the past. Time-shifting does not pollute the file system namespace nor require snapshots to be mounted as a separate file system. Further, ext3cow is i ...

**Keywords:** Versioning file systems, copy-on-write

### 2 [Fast detection of communication patterns in distributed executions](#)

Thomas Kunz, Michiel F. H. Seuren

November 1997 **Proceedings of the 1997 conference of the Centre for Advanced Studies on Collaborative research**

Publisher: IBM Press

Full text available: [pdf\(4.21 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Understanding distributed applications is a tedious and difficult task. Visualizations based on process-time diagrams are often used to obtain a better understanding of the execution of the application. The visualization tool we use is Poet, an event tracer developed at the University of Waterloo. However, these diagrams are often very complex and do not provide the user with the desired overview of the application. In our experience, such tools display repeated occurrences of non-trivial commun ...

### 3 [Services: ELF: an efficient log-structured flash file system for micro sensor nodes](#)



Hui Dai, Michael Neufeld, Richard Han

November 2004 **Proceedings of the 2nd international conference on Embedded networked sensor systems**

Publisher: ACM Press

Full text available: [pdf\(291.68 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

An efficient and reliable file storage system is important to micro sensor nodes so that



data can be logged for later asynchronous delivery across a multi-hop wireless sensor network. Designing and implementing such a file system for a sensor node faces various challenges. Sensor nodes are highly resource constrained in terms of limited runtime memory, limited persistent storage, and finite energy. Also, the flash storage medium on sensor nodes differs in a variety of ways from the traditional ...

**Keywords:** eeprom, file system, flash, log structured, reliability, sensor

#### 4 An algebraic approach to file synchronization



Norman Ramsey, El'od Csirmaz

September 2001

**ACM SIGSOFT Software Engineering Notes , Proceedings of the 8th European software engineering conference held jointly with 9th ACM SIGSOFT international symposium on Foundations of software engineering ESEC/FSE-9, Volume 26 Issue 5**

**Publisher:** ACM Press

Full text available: [pdf\(301.78 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

A *file synchronizer* restores consistency after multiple replicas of a filesystem have been changed independently. We present an algebra for reasoning about operations on filesystems and show that it is sound and complete with respect to a simple model. The algebra enables us to specify a file-synchronization algorithm that can be combined with several different conflict-resolution policies. By contrast, previous work builds the conflict-resolution policy into the specification, or worse, ...

#### 5 Lineage retrieval for scientific data processing: a survey



Rajendra Bose, James Frew

March 2005 **ACM Computing Surveys (CSUR)**, Volume 37 Issue 1

**Publisher:** ACM Press

Full text available: [pdf\(728.75 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Scientific research relies as much on the dissemination and exchange of data sets as on the publication of conclusions. Accurately tracking the lineage (origin and subsequent processing history) of scientific data sets is thus imperative for the complete documentation of scientific work. Researchers are effectively prevented from determining, preserving, or providing the lineage of the computational data products they use and create, however, because of the lack of a definitive model for lineage ...

**Keywords:** Data lineage, audit, data provenance, scientific data, scientific workflow

#### 6 Real-time shading



Marc Olano, Kurt Akeley, John C. Hart, Wolfgang Heidrich, Michael McCool, Jason L. Mitchell, Randi Rost

August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

**Publisher:** ACM Press

Full text available: [pdf\(7.39 MB\)](#) Additional Information: [full citation](#), [abstract](#)

Real-time procedural shading was once seen as a distant dream. When the first version of this course was offered four years ago, real-time shading was possible, but only with one-of-a-kind hardware or by combining the effects of tens to hundreds of rendering passes. Today, almost every new computer comes with graphics hardware capable of interactively executing shaders of thousands to tens of thousands of instructions. This course has been redesigned to address today's real-time shading capabilities ...



## 7 Visualizing geospatial data



Theresa Marie Rhyne, Alan MacEachern, Theresa-Marie Rhyne

August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

**Publisher:** ACM Press

Full text available: [pdf\(13.99 MB\)](#) Additional Information: [full citation](#), [abstract](#)

This course reviews concepts and highlights new directions in GeoVisualization. We review four levels of integrating geospatial data and geographic information systems (GIS) with scientific and information visualization (VIS) methods. These include:• Rudimentary: minimal data sharing between the GIS and Vis systems• Operational: consistency of geospatial data• Functional: transparent communication between the GIS and Vis systems• Merged: one comprehensive toolkit environmentW ...

## 8 Speculative execution in a distributed file system



Edmund B. Nightingale, Peter M. Chen, Jason Flinn

October 2005 **ACM SIGOPS Operating Systems Review , Proceedings of the twentieth ACM symposium on Operating systems principles SOSP '05**, Volume 39 Issue 5

**Publisher:** ACM Press

Full text available: [pdf\(305.54 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Speculator provides Linux kernel support for speculative execution. It allows multiple processes to share speculative state by tracking causal dependencies propagated through inter-process communication. It guarantees correct execution by preventing speculative processes from externalizing output, e.g., sending a network message or writing to the screen, until the speculations on which that output depends have proven to be correct. Speculator improves the performance of distributed file systems ...

**Keywords:** causality, distributed file systems, speculative execution

## 9 Routing design in operational networks: a look from the inside



Geoffrey Xie, Jibin Zhan, David A. Maltz, Hui Zhang, Albert Greenberg, Gísli Hjálmtýsson

August 2004 **ACM SIGCOMM Computer Communication Review , Proceedings of the 2004 conference on Applications, technologies, architectures, and protocols for computer communications SIGCOMM '04**, Volume 34 Issue 4

**Publisher:** ACM Press

Full text available: [pdf\(372.95 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

In any IP network, routing protocols provide the intelligence that takes a collection of physical links and transforms them into a network that enables packets to travel from one host to another. Though routing design is arguably the single most important design task for large IP networks, there has been very little systematic investigation into how routing protocols are actually used in production networks to implement the goals of network architects. We have developed a methodology for reverse ...

**Keywords:** network modeling, reverse engineering, routing design, static configuration analysis

## 10 Kernel korner: IBM's journaled filesystem



Steve Best, David Gordon, Ibrahim Haddad

January 2003 **Linux Journal**, Volume 2003 Issue 105

**Publisher:** Specialized Systems Consultants, Inc.

Full text available: [html\(20.45 KB\)](#) Additional Information: [full citation](#), [index terms](#)



### 11 Soft updates: a solution to the metadata update problem in file systems



Gregory R. Ganger, Marshall Kirk McKusick, Craig A. N. Soules, Yale N. Patt  
May 2000 **ACM Transactions on Computer Systems (TOCS)**, Volume 18 Issue 2

**Publisher:** ACM Press

Full text available: [pdf\(147.90 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citings](#), [index terms](#)

Metadata updates, such as file creation and block allocation, have consistently been identified as a source of performance, integrity, security, and availability problems for file systems. Soft updates is an implementation technique for low-cost sequencing of fine-grained updates to write-back cache blocks. Using soft updates to track and enforce metadata update dependencies, a file system can safely use delayed writes for almost all file operations. This article describes soft ...

### 12 A Self-Organizing Storage Cluster for Parallel Data-Intensive Applications

Hong Tang, Aziz Gulbeden, Jingyu Zhou, William Strathearn, Tao Yang, Lingkun Chu  
November 2004 **Proceedings of the 2004 ACM/IEEE conference on Supercomputing**

**Publisher:** IEEE Computer Society

Full text available: [pdf\(330.26 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Cluster-based storage systems are popular for data-intensive applications and it is desirable yet challenging to provide incremental expansion and high availability while achieving scalability and strong consistency. This paper presents the design and implementation of a self-organizing storage cluster called Sorrento, which targets data-intensive workload with highly parallel requests and low write-sharing patterns. Sorrento automatically adapts to storage node joins and departures, and the sys ...

### 13 Web3D in ocean science learning environments: virtual big beef creek



Bruce Campbell, Paul Collins, Hunter Hadaway, Nick Hedley, Mark Stoermer  
February 2002 **Proceeding of the seventh international conference on 3D Web technology**

**Publisher:** ACM Press

Full text available: [pdf\(387.03 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The Virtual Reality Modeling Language (VRML), Java 3D software development packages, and World Wide Web (the Web) offer great potential for delivering three-dimensional, collaborative virtual environments to broad, on-line audiences. These capabilities have significant potential in ocean sciences, so a visualization environment was developed to explore these possibilities. The University of Washington's Virtual Big Beef Creek (VBBC) project has been continuously refined since its initial impleme ...

**Keywords:** VRML, interface paradigms, virtual environments, virtual geography, virtual worlds

### 14 Dynamic Metadata Management for Petabyte-Scale File Systems

Sage A. Weil, Kristal T. Pollack, Scott A. Brandt, Ethan L. Miller  
November 2004 **Proceedings of the 2004 ACM/IEEE conference on Supercomputing**

**Publisher:** IEEE Computer Society

Full text available: [pdf\(175.04 KB\)](#) Additional Information: [full citation](#), [abstract](#)

In petabyte-scale distributed file systems that decouple read and write from metadata operations, behavior of the metadata server cluster will be critical to overall system performance and scalability. We present a dynamic subtree partitioning and adaptive metadata management system designed to efficiently manage hierarchical metadata



workloads that evolve over time. We examine the relative merits of our approach in the context of traditional workload partitioning strategies, and demonstrate the ...

### 15 Papers: Information visualization: PhotoMesa: a zoomable image browser using quantum treemaps and bubblemaps



Benjamin B. Bederson

November 2001 **Proceedings of the 14th annual ACM symposium on User interface software and technology**

**Publisher:** ACM Press

Full text available: pdf(1.34 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

PhotoMesa is a zoomable image browser that uses a novel treemap algorithm to present large numbers of images grouped by directory, or other available metadata. It uses a new interaction technique for zoomable user interfaces designed for novices and family use that makes it straightforward to navigate through the space of images, and impossible to get lost. PhotoMesa groups images using one of two new algorithms that lay out groups of objects in a 2D space-filling manner. *Quantum treemaps* ...

**Keywords:** Animation, Graphics, Image Browsers, Jazz, Treemaps, Zoomable User Interfaces (ZUIs)

### 16 Frangipani: a scalable distributed file system



Chandramohan A. Thekkath, Timothy Mann, Edward K. Lee

October 1997 **ACM SIGOPS Operating Systems Review , Proceedings of the sixteenth ACM symposium on Operating systems principles SOSP '97**, Volume 31 Issue 5

**Publisher:** ACM Press

Full text available: pdf(2.20 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

### 17 The Integrated Dictionary/Directory System



Frank W. Allen, Mary E. S. Loomis, Michael V. Mannino

June 1982 **ACM Computing Surveys (CSUR)**, Volume 14 Issue 2

**Publisher:** ACM Press

Full text available: pdf(2.71 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

### 18 IRON file systems



Vijayan Prabhakaran, Lakshmi N. Bairavasundaram, Nitin Agrawal, Haryadi S. Gunawi, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau

October 2005 **ACM SIGOPS Operating Systems Review , Proceedings of the twentieth ACM symposium on Operating systems principles SOSP '05**, Volume 39 Issue 5

**Publisher:** ACM Press

Full text available: pdf(323.82 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Commodity file systems trust disks to either work or fail completely, yet modern disks exhibit more complex failure modes. We suggest a new *fail-partial failure model* for disks, which incorporates realistic localized faults such as latent sector errors and block corruption. We then develop and apply a novel *failure-policy fingerprinting* framework, to investigate how commodity file systems react to a range of more realistic disk failures. We classify their failure policies in a new ...



**Keywords:** IRON file systems, block corruption, disks, fail-partial failure model, fault tolerance, internal, latent sector errors, redundancy, reliability, storage

19 Embedded systems: applications, solutions and techniques (EMBS): A fast start-up technique for flash memory based computing systems



Keun Soo Yim, Jihong Kim, Kern Koh

March 2005 **Proceedings of the 2005 ACM symposium on Applied computing**

**Publisher:** ACM Press

Full text available: [pdf\(324.29 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Flash memory based embedded computing systems are becoming increasingly prevalent. These systems typically have to provide an instant start-up time. However, we observe that mounting a file system for flash memory takes 1 to 25 seconds mainly depending on the flash capacity. Since the flash chip capacity is doubled in every year, this mounting time will soon become the most dominant reason of the delay of system start-up time. Therefore, in this paper, we present instant mounting techniques for ...

**Keywords:** fast booting, fast mounting, flash memory, metadata snapshot

20 A Computational Database System for Generating Unstructured Hexahedral Meshes with Billions of Elements



Tiankai Tu, David R. O'Hallaron

November 2004 **Proceedings of the 2004 ACM/IEEE conference on Supercomputing**

**Publisher:** IEEE Computer Society

Full text available: [pdf\(222.13 KB\)](#) Additional Information: [full citation](#), [abstract](#)

For a large class of physical simulations with relatively simple geometries, unstructured octree-based hexahedral meshes provide a good compromise between adaptivity and simplicity. However, generating unstructured hexahedral meshes with over 1 billion elements remains a challenging task. We propose a database approach to solve this problem. Instead of merely storing generated meshes into conventional databases, we have developed a new kind of software system called Computational Database System ...

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### 1 [4.2BSD and 4.3BSD as examples of the UNIX system](#)


 John S. Quarterman, Abraham Silberschatz, James L. Peterson  
 December 1985 **ACM Computing Surveys (CSUR)**, Volume 17 Issue 4

Publisher: ACM Press

 Full text available: [pdf\(4.07 MB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

This paper presents an in-depth examination of the 4.2 Berkeley Software Distribution, Virtual VAX-11 Version (4.2BSD), which is a version of the UNIX Time-Sharing System. There are notes throughout on 4.3BSD, the forthcoming system from the University of California at Berkeley. We trace the historical development of the UNIX system from its conception in 1969 until today, and describe the design principles that have guided this development. We then present the internal data structures and ...

### 2 [On-line data compression in a log-structured file system](#)


 Michael Burrows, Charles Jerian, Butler Lampson, Timothy Mann  
 September 1992 **ACM SIGPLAN Notices , Proceedings of the fifth international conference on Architectural support for programming languages and operating systems ASPLOS-V**, Volume 27 Issue 9

Publisher: ACM Press

 Full text available: [pdf\(1.02 MB\)](#)

 Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

### 3 [Making Inodes Behave](#)


 Clay Claiborne  
 February 2001 **Linux Journal**

Publisher: Specialized Systems Consultants, Inc.

 Full text available: [html\(19.47 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Claiborne describes the difficulties he encountered while building Linux systems for General Dynamics.

### 4 [Deciding when to forget in the Elephant file system](#)


 Douglas S. Santry, Michael J. Feeley, Norman C. Hutchinson, Alistair C. Veitch, Ross W. Carton, Jacob Ofir  
 December 1999 **ACM SIGOPS Operating Systems Review , Proceedings of the seventeenth ACM symposium on Operating systems principles SOSP**



'99, Volume 33 Issue 5

Publisher: ACM Press

Full text available:  pdf(1.61 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Modern file systems associate the deletion of a file with the immediate release of storage, and file writes with the irrevocable change of file contents. We argue that this behavior is a relic of the past, when disk storage was a scarce resource. Today, large cheap disks make it possible for the file system to protect valuable data from accidental delete or overwrite. This paper describes the design, implementation, and performance of the Elephant file system, which automatically retains all impo ...

## 5 Research session: XML query processing #1: Efficient processing of XML path queries using the disk-based F&B Index

Wei Wang, Haifeng Jiang, Hongzhi Wang, Xuemin Lin, Hongjun Lu, Jianzhong Li

August 2005 **Proceedings of the 31st international conference on Very large data bases VLDB '05**

Publisher: VLDB Endowment

Full text available:  pdf(371.23 KB)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

With the proliferation of XML data and applications on the Internet, efficient XML query processing techniques are in great demand. Answering queries using XML indexes is a natural approach. A number of XML indexes have been proposed in the literature: among them, F&B Index is one powerful index as it is the smallest index that answers all twig queries. However, an F&B Index suffers from the following two problems: (1) it was originally proposed as a memory-based index while its size is usually ...

## 6 The design and implementation of a log-structured file system



Mendel Rosenblum, John K. Ousterhout

February 1992 **ACM Transactions on Computer Systems (TOCS)**, Volume 10 Issue 1

Publisher: ACM Press

Full text available:  pdf(1.97 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

This paper presents a new technique for disk storage management called a log-structured file system. A log-structured file system writes all modifications to disk sequentially in a log-like structure, thereby speeding up both file writing and crash recovery. The log is the only structure on disk; it contains indexing information so that files can be read back from the log efficiently. In order to maintain large free areas on disk for fast writing, we divide the log into

**Keywords:** Unix, disk storage management, fast crash recovery, file system organization, file system performance, high write performance, log-structured, logging

## 7 The design and implementation of a log-structured file system



Mendel Rosenblum, John K. Ousterhout

September 1991 **ACM SIGOPS Operating Systems Review , Proceedings of the thirteenth ACM symposium on Operating systems principles SOSP**

'91, Volume 25 Issue 5

Publisher: ACM Press

Full text available:  pdf(1.81 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper presents a new technique for disk storage management called a *log-structured file system*. A log-structured file system writes all modifications to disk sequentially in a log-like structure, thereby speeding up both file writing and crash recovery. The log is the only structure on disk; it contains indexing information so that files can be read back from the log efficiently. In order to maintain large free areas on disk for fast writing, we divide



the log into *segments* an ...


## 8 Improving the efficiency of UNIX buffer caches

 A. Braunstein, M. Riley, J. Wilkes  
November 1989 **ACM SIGOPS Operating Systems Review , Proceedings of the twelfth ACM symposium on Operating systems principles SOSP '89**, Volume 23  
Issue 5  
**Publisher:** ACM Press

Full text available:  [pdf\(1.46 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper reports on the effects of using hardware virtual memory assists in managing file buffer caches in UNIX. A controlled experimental environment was constructed from two systems whose only difference was that one of them (XMF) used the virtual memory hardware to assist file buffer cache search and retrieval. An extensive series of performance characterizations was used to study the effects of varying the buffer cache size (from 3 Megabytes to 70 MB); I/O transfer sizes (from ...

## 9 Improving storage system availability with D-GRAID

 Muthian Sivathanu, Vijayan Prabhakaran, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau  
May 2005 **ACM Transactions on Storage (TOS)**, Volume 1 Issue 2  
**Publisher:** ACM Press

Full text available:  [pdf\(700.30 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present the design, implementation, and evaluation of D-GRAID, a gracefully degrading and quickly recovering RAID storage array. D-GRAID ensures that most files within the file system remain available even when an unexpectedly high number of faults occur. D-GRAID achieves high availability through aggressive replication of semantically critical data, and fault-isolated placement of logically related data. D-GRAID also recovers from failures quickly, restoring only live file system data to a h ...

**Keywords:** Block-based storage, Disk array, RAID, fault isolation, file systems, smart disks


## 10 Fault tolerance under UNIX

 Anita Borg, Wolfgang Blau, Wolfgang Graetsch, Ferdinand Herrmann, Wolfgang Oberle  
January 1989 **ACM Transactions on Computer Systems (TOCS)**, Volume 7 Issue 1  
**Publisher:** ACM Press

Full text available:  [pdf\(1.97 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

The initial design for a distributed, fault-tolerant version of UNIX based on three-way atomic message transmission was presented in an earlier paper [3]. The implementation effort then moved from Auragen Systems<sup>1</sup> to Nixdorf Computer where it was completed. This paper describes the working system, now known as the TARGON/32. The original design left open questions in at least two areas: fault tolerance for server processes and recovery after a crash were brie ...

## 11 Frangipani: a scalable distributed file system

 Chandramohan A. Thekkath, Timothy Mann, Edward K. Lee  
October 1997 **ACM SIGOPS Operating Systems Review , Proceedings of the sixteenth ACM symposium on Operating systems principles SOSP '97**, Volume 31 Issue 5  
**Publisher:** ACM Press

Full text available:  [pdf\(2.20 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)



## 12 Techniques to increase disk access locality in the Minorca multimedia file system



Chuanbao Wang, Vera Goebel, Thomas Plagemann

October 1999 **Proceedings of the seventh ACM international conference on Multimedia (Part 2)**

Publisher: ACM Press

Full text available: pdf(483.67 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

**Keywords:** access locality, continuous media, disk layout, disk seek, read ahead

## 13 The file system of an integrated local network



Paul J. Leach, Paul H. Levine, James A. Hamilton, Bernard L. Stumpf

March 1985 **Proceedings of the 1985 ACM thirteenth annual conference on Computer Science**

Publisher: ACM Press

Full text available: pdf(1.78 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The distributed file system component of the DOMAIN system is described. The DOMAIN system is an architecture for networks of personal workstations and servers which creates an integrated distributed computing environment. The distinctive features of the file system include: objects addressed by unique identifiers (UIDs); transparent access to objects, regardless of their location in the network; the abstraction of a single level store for accessing all objects; and the layering of a network ...

## 14 A high resolution disk I/O trace system



Tao Huang, Teng Xu, Xianliang Lu

October 2001 **ACM SIGOPS Operating Systems Review**, Volume 35 Issue 4

Publisher: ACM Press

Full text available: pdf(377.26 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Disk access patterns are more important to understand as the gap between processor and disk performance is increasing. Obtaining disk I/O traces from real system is the first step to analyze disk access patterns, and tracing disk I/O is the first step to obtain disk I/O traces from real system. This paper implements a high resolution disk I/O trace system built into Linux, without adding noticeable processor load to the system. Each trace record contains the following content about a single physics ...

**Keywords:** Disk access pattern, Hard disk, Linux, Trace

## 15 Implementing global memory management in a workstation cluster



M. J. Feeley, W. E. Morgan, E. P. Pighin, A. R. Karlin, H. M. Levy, C. A. Thekkath

December 1995 **ACM SIGOPS Operating Systems Review , Proceedings of the fifteenth ACM symposium on Operating systems principles SOSP '95**, Volume 29 Issue 5

Publisher: ACM Press

Full text available: pdf(1.52 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

## 16 ECOSystem: managing energy as a first class operating system resource

Heng Zeng, Carla S. Ellis, Alvin R. Lebeck, Amin Vahdat





October 2002 **ACM SIGPLAN Notices , ACM SIGARCH Computer Architecture News , ACM SIGOPS Operating Systems Review , Proceedings of the 10th international conference on Architectural support for programming languages and operating systems ASPLOS-X**, Volume 37 , 30 , 36 Issue 10 , 5 , 5

**Publisher:** ACM Press

Full text available: pdf(1.17 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

Energy consumption has recently been widely recognized as a major challenge of computer systems design. This paper explores how to support energy as a first-class operating system resource. Energy, because of its global system nature, presents challenges beyond those of conventional resource management. To meet these challenges we propose the Currentcy Model that unifies energy accounting over diverse hardware components and enables fair allocation of available energy among applications. Our par ...

## 17 A generalized text editor



Christopher W. Fraser

March 1980 **Communications of the ACM**, Volume 23 Issue 3

**Publisher:** ACM Press

Full text available: pdf(512.06 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

Text is not the only data that needs editing; for example, file deletion utilities edit directories. If all "editors" used the same command language, they would be easier to learn, remember, and code. This paper describes a generalized editor that edits text, directories, binary core images, and certain operating system data with a single user interface.

**Keywords:** CRT, command language, editor, text

## 18 Probing the black box: Transforming policies into mechanisms with infokernel



Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau, Nathan C. Burnett, Timothy E. Denehy, Thomas J. Engle, Haryadi S. Gunawi, James A. Nugent, Florentina I. Popovici

October 2003 **Proceedings of the nineteenth ACM symposium on Operating systems principles**

**Publisher:** ACM Press

Full text available: pdf(365.12 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We describe an evolutionary path that allows operating systems to be used in a more flexible and appropriate manner by higher-level services. An infokernel exposes key pieces of information about its algorithms and internal state; thus, its default policies become mechanisms, which can be controlled from user-level. We have implemented two prototype infokernels based on the linuxtwofour and netbsdver kernels, called infolinux and infobsd, respectively. The infokernels export key abstractions as ...

**Keywords:** information, mechanism, policy

## 19 Implementing cooperative prefetching and caching in a globally-managed memory system



Geoffrey M. Voelker, Eric J. Anderson, Tracy Kimbrel, Michael J. Feeley, Jeffrey S. Chase, Anna R. Karlin, Henry M. Levy

June 1998 **ACM SIGMETRICS Performance Evaluation Review , Proceedings of the 1998 ACM SIGMETRICS joint international conference on Measurement and modeling of computer systems SIGMETRICS '98/PERFORMANCE '98**, Volume 26 Issue 1



**Publisher:** ACM Press

Full text available:  pdf(1.66 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper presents *cooperative prefetching and caching* --- the use of network-wide global resources (memories, CPUs, and disks) to support prefetching and caching in the presence of hints of future demands. Cooperative prefetching and caching effectively unites disk-latency reduction techniques from three lines of research: prefetching algorithms, cluster-wide memory management, and parallel I/O. When used together, these techniques greatly increase the power of prefetching relative to a ...

## 20 [Measuring file access patterns in UNIX](#)



Irene Hu

August 1986 **ACM SIGMETRICS Performance Evaluation Review**, Volume 14 Issue 2

**Publisher:** ACM Press

Full text available:  pdf(473.91 KB) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

UNIX is a disk-based operating system, where only the system kernel is always memory-resident. A combination of small block size, limited read-ahead and numerous seeks can severely limit the file system throughput. This paper presents a tool to study the file access patterns. Information derived from the data collected can be used to determine the optimal disk block size and also to improve the block placement strategy. The tool is a software monitor, installed at the device driver level, and tr ...

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File Format: PDF/Adobe Acrobat

backup **file** by **file**. Snapshots are the equivalent of raw backups, the. **snapshot** hardware has **no** facility for handling **meta-data**. It is the backup ...www.naspa.com/PDF/2004/1204/N0412006.pdf - [Similar pages](#)**[PDF] A Storage Networking Appliance**File Format: PDF/Adobe Acrobat - [View as HTML](#)consumes **no** disk space until **files** referenced by a **Snapshot** are deleted or modified.... Like Episode, WAFL uses **files** to **store meta-data**. ...www.netapp.com/tech\_library/3001.html - [Similar pages](#)**[PDF] STREAMLINING ORACLE E-BUSINESS SUITE 11 i OPERATIONS AND MIGRATION ...**File Format: PDF/Adobe Acrobat - [View as HTML](#)A **Snapshot file** can be. created in just a few seconds and uses **no** ... Once a**Snapshot file** is created, the **storage** appliance can back up the database ...www.netapp.com/tech\_library/3310.html - [Similar pages](#)**[PDF] Meta-data Snapshotting: A Simple Mechanism for File System Consistency**File Format: PDF/Adobe Acrobat - [View as HTML](#)altered **meta-data** blocks, representing such **files**, in a **snapshot**. The **snapshot** will be scheduled to be written to stable **storage** ...www.research.ibm.com/K42/papers/snapi03.pdf - [Similar pages](#)**snapsfs**... is that if all the filesystem **metadata** is flushed before making the **snapshot**,... tiny **files**. ext2fs **stores** short symlinks within the inode itself. ...sourcefrog.net/projects/snapsfs/ - 18k - [Cached](#) - [Similar pages](#)**Network File System Version 4 (nfsv4) Charter**



2.7.9 Network File System Version 4 (nfsv4). NOTE: This charter is a **snapshot** of the 62nd IETF Meeting in Minneapolis, MN USA. It may now be out-of-date. ...  
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**[PDF] Richer File System Metadata Using Links and Attributes**

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employ far richer **metadata** structures. File systems design-ers will **no** longer be ... the underlying Linux **file** system for data **storage**. Initial ...

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[www.stbernard.com](http://www.stbernard.com)**Snapshot File Systems**When an **inode** update or a write changes the data in block n of the snapped **file system**, the old data is first read and copied to the **snapshot** before the ...[docs.hp.com/en/B3929-90011/ch04s02.html](http://docs.hp.com/en/B3929-90011/ch04s02.html) - 28k - [Cached](#) - [Similar pages](#)**Using a Snapshot File System for Backup**The **file system** may have some extended **inode** operations that must be completed, though there should be no other changes. Since the **snapshot file system** is ...[docs.hp.com/en/B3929-90011/ch04s03.html](http://docs.hp.com/en/B3929-90011/ch04s03.html) - 31k - [Cached](#) - [Similar pages](#)[ [More results from docs.hp.com](#) ]**LFS: A Log Structured File System for Linux that Supports Snapshots**Traditional **file systems** like ext2 usually write **inode** blocks at a fixed place ... No currentLinux **file system** supports **snapshots** and implementing a **file** ...[logfs.sourceforge.net/](http://logfs.sourceforge.net/) - 10k - [Cached](#) - [Similar pages](#)**[PDF] A Log Structured File System with Snapshots**File Format: PDF/Adobe Acrobat - [View as HTML](#)Figure 4: **Snapshots**. shown in (4). Note that the **inode** map itself is a **file** in our **file system** and modification of **inode** map results ...[www.eecs.umich.edu/~ppadala/soc/lfs.pdf](http://www.eecs.umich.edu/~ppadala/soc/lfs.pdf) - [Similar pages](#)**The snapshot archive available at this web site contains snapshot ...**For example, 15Oct94/sd2g contains the **snapshot** of the glan5 **file system**. ... It describes the **file** corresponding to the **inode**. number = **inode** number gen ...[www.eecs.harvard.edu/~keith/snapshots/description](http://www.eecs.harvard.edu/~keith/snapshots/description) - 4k - [Cached](#) - [Similar pages](#)**GPFS V2.3 Administration and Programming Reference ...**gpfs\_open\_inodescan() Subroutine. Name. gpfs\_open\_inodescan() - Opens an **inode** scan of a **file system** or **snapshot**. Library. GPFS Library (libgpfs.a for AIX, ...[publib.boulder.ibm.com/infocenter/clresctr/](http://publib.boulder.ibm.com/infocenter/clresctr/)[topic.com.ibm.cluster.gpfs.doc/gpfs23/bl1adm10/bl1adm10161.html](http://topic.com.ibm.cluster.gpfs.doc/gpfs23/bl1adm10/bl1adm10161.html) - 11k -[Cached](#) - [Similar pages](#)**GPFS V2.3 Administration and Programming Reference - Managing GPFS ...****Snapshots** are exact copies of changed data in the active **files** and directories of a **file system** with the exception of the **inode** number. ...[publib.boulder.ibm.com/infocenter/clresctr/](http://publib.boulder.ibm.com/infocenter/clresctr/)[topic.com.ibm.cluster.gpfs.doc/gpfs23/bl1adm10/bl1adm1030.html](http://topic.com.ibm.cluster.gpfs.doc/gpfs23/bl1adm10/bl1adm1030.html) - 18k -[Cached](#) - [Similar pages](#)**Network storage file systems for the enterprise**All **file systems** have inodes, or something similar. Until recently **file system** designers



studiously attempted to minimize **inode** size (typically 64 or 128 ...  
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**PDF] An Efficient Snapshot Technique for Ext3 File System in Linux 2.6**

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In this paper, we develop a **file system**-based **snapshot** for the ext3 **file** ... and the struct **inode** defines all information needed. by the **file system** to ...

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**snapsfs**

If the **system** wants to write to a data block, **inode**, or directory entry used by a previous **snapshot**, then the **filesystem** transparently allocates a block ...  
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**Network storage file systems for the enterprise**

... disk usage by integrating **Snapshot** features directly into their **file systems** ... Additionally 50% of all **files** are small enough to be included in **inode** ...  
[www.traakan.com/products\\_features.html](#) - 20k - [Cached](#) - [Similar pages](#)

**GNU tar**

If you don't use `--incremental` ( `-G` ), the **file system** will probably fill up with **files** that shouldn't exist any more. `--listed-incremental= snapshot-file` ...  
[www.delorie.com/gnu/docs/tar/tar\\_78.html](#) - 10k - [Cached](#) - [Similar pages](#)

**inode.5**

... list of **snapshot inode** numbers `*/` back to stuff that has been around a ... The root **inode** is the root of the **file system**. **Inode** 0 can't be used for ...  
[www.daemon-systems.org/man/inode.5.html](#) - 17k - [Cached](#) - [Similar pages](#)

**Glossary**

**inode**. A unique identifier for each **file** within a **file system** which also ... A **file system** whose exact image has been used to create a **snapshot file system**. ...  
[uw713doc.sco.com/ODM\\_FSadmin/fssag-12.html](#) - 14k - [Cached](#) - [Similar pages](#)

**Introspective: What's a Snapshot Backup?**

Performing a restore merely requires finding the **filesystem snapshot** for the ... Each unique **file** on the **filesystem** has a magic number, called an **inode**, ...  
[edseek.com/~jasonb/articles/dirvish\\_backup/snapshot.html](#) - 10k - [Cached](#) - [Similar pages](#)

**The ext3cow File System**

... enhanced version of ext3 that allows one to take a **snapshot** of one's **file system**, ... For every version of a **file** that exists, an **inode** must exist to ...  
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**[PDF] Journaled File System (JFS) for Linux UT, Texas April 25, 2003**

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**File layout (inode** containing the root of a B+tree which ... Setup the volume to use as the **snapshot**. Stop the **File System** operations (VFS operation) ...  
[www.cs.utexas.edu/users/ygz/378-03S/IBM-jfs.pdf](#) - [Similar pages](#)

**Linux Kernel 2.4 Internals: Virtual Filesystem (VFS)**

This brings us from **inode** cache back to the **filesystem** code - remember that ... If this was an anonymous **inode** (NetApp **snapshot**) then we delete it from the ...  
[www.faqs.org/docs/kernel\\_2\\_4/lki-3.html](#) - 62k - [Cached](#) - [Similar pages](#)

**Re: how to use LVM snapshot with ext3 - VFS lock patch applicability**

... to copy the original `>superblock`, **inode** tables, etc to the **snapshot** once. ... I would like to make a **snapshot** of my **filesystem** while the application is ...



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### Generating data set of the first file system by determining a set ...

The data **stored** within **files** in a **file** system have associated **metadata** to describe the data and ... If all more recent **snapshots** contain a "**ditto**" **address**, ...

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### Generating data set of the first file system by determining a set ...

The data **stored** within **files** in a **file** system have associated **metadata** to ... If all more recent **snapshots** contain a "**ditto**" **address**, the lack of a more ...

[www.patentstorm.us/patents/6959310.html](http://www.patentstorm.us/patents/6959310.html) - 176k - [Cached](#) - [Similar pages](#)

### Mac OS X Enterprise Application Management Best Practices

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**ditto** is a **command** line tool which supports copying **files** and folders ... Mac OS X. Many applications under Mac OS X **store metadata** in a "resource fork", ...

[macenterprise.org/dmdocuments/20041020-937\\_bestpractices.pdf](http://macenterprise.org/dmdocuments/20041020-937_bestpractices.pdf) - [Similar pages](#)

### IBM Globalization - Terminology

Virtual images are **stored** in the integrated **file** system and can be in either ...

**Metadata** about these resources resides in a directory on the **file** system; ...

[www-306.ibm.com/software/globalization/terminology/vw.html](http://www-306.ibm.com/software/globalization/terminology/vw.html) - 145k - [Cached](#) - [Similar pages](#)

### PostgreSQL

The dump (**snapshot**) **file** has just the ASCII SQL **commands** that specify the table contents. ... Dump the **address** book database to a dump **file**, including OIDs. ...

[linuxmafia.com/faq/Apps/postgresql.html](http://linuxmafia.com/faq/Apps/postgresql.html) - 42k - [Cached](#) - [Similar pages](#)

### Planet Sun (solaris)

To create a **snapshot** of our ZFS filesystem, we can use the **command**: ... You'll also need to **modify** your environment **file** to enable non-debug builds. ...

[planetsun.org/filter/solaris/](http://planetsun.org/filter/solaris/) - 101k - Dec 20, 2005 - [Cached](#) - [Similar pages](#)

### Mainframe Appliance for Storage

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... updated/changed in order to support "**snapshot**" backups ... or Microsoft's Common Internet File System (CIFS ... the gigabit Ethernet interface with an IP **address**. ...

[www.bustech.com/support/downloads/mas/40-02114-B0-001.pdf](http://www.bustech.com/support/downloads/mas/40-02114-B0-001.pdf) - Supplemental Result - [Similar pages](#)

### ditto: Mac OS X

Anyway, I'm planning to make it use all system **commands** (mostly **ditto**) ...

Nothing in a Mac OS X 10.4 could be as cool as a **metadata** driven **file** system! ...

[sean.typepad.com/ditto/mac\\_os\\_x/](http://sean.typepad.com/ditto/mac_os_x/) - 348k - [Cached](#) - [Similar pages](#)

### Subversion Dev: [PATCH book] Use of <quote> over "

-106,14 +106,15 @@ <firstterm>lock-**modify**-unlock</firstterm> model to **address**

... commit</command> of the **file** will fail with an "out-of-date" - error. ...

[svn.haxx.se/dev/archive-2003-03/1274.shtml](http://svn.haxx.se/dev/archive-2003-03/1274.shtml) - 88k - [Cached](#) - [Similar pages](#)

### Integrity Checking For Process Hardening



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Other invalid **command**. Invalid shell **command**. File name binding. Directory confinement.

File name collision. Other **metadata**. Format string. Buffer overflow ...

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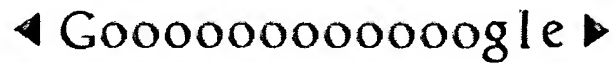
**procmal history file (snapshot)**It is derived from the HISTORY file that is included in **source** distributions.The latest **snapshot** can be found at ...[www.procmal.org/procmal-history.html](http://www.procmal.org/procmal-history.html) - 33k - [Cached](#) - [Similar pages](#)**CHAPTER 5 RootCause Demo**Click on the pi\_demo.cpp **source file** node, then right-click to see the Trace ...In this small demo, a **snapshot** is not really necessary since it doesn't ...[www.ocsystems.com/user\\_guide/rootcause/win/html/rcc-8.htm](http://www.ocsystems.com/user_guide/rootcause/win/html/rcc-8.htm) - 27k - [Cached](#) - [Similar pages](#)**C++ Development Environment - ugu**The PCH file contains a **snapshot** of all the code preceding the header stop point,typically the first token in the primary **source file** that does not belong ...[h30097.www3.hp.com/cplus/ugu\\_pch.html](http://h30097.www3.hp.com/cplus/ugu_pch.html) - 35k - [Cached](#) - [Similar pages](#)**ScatterWeb.APP: Applications/PictureIt!/ESB/src/ScatterWeb.Camera ...**00006 00007 Redistribution and use in **source** and binary forms, with or without

00008 modification, ... 00054 #define CAMERA\_SYNCH (0x0D) // Initial Camera. ...

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... 3 3 Writing **initial** simulation **snapshot**: worklib.test:v Loading **snapshot** ...  
Done ncsim> **source** /usr/ldv/tools/inca/files/ncsimrc ncsim> run FAILED ab=0 ...  
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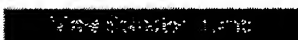
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Symposium on  
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